Remarks

Summary of the Amendment of the Claims

The claims have been amended specifically to address the objections raised by the Examiner under 35USC §112 by inserting antecedent basis where requested by the Examiner. Claims 16, 21 and 22 have also been amended to use the American spellings of depressurization and repressurization. Claim 26 has been reworded to improve its clarity by making the relationship to the earlier claims more immediately apparent. Applicants submit that no new matter has been added by virtue of these amendments.

Summary of the Amendments to the Specification

Amendments have been made in the Specification in line with the Examiner's helpful suggestions in paragraph 9 of the Action. Applicants submit that no new matter has been added by virtue of these amendments.

Rejection under 35 USC §112, second paragraph

Each of the objections raised in the Office Action has been individually addressed by the claim amendments referred to above.

Rejection under 35USC §102b

Claims 1, 3-18 and 20-26 have been rejected as lacking novelty over US-5,958,109 ("Fuderer"), which is said to disclose TSA using adsorption beds that overlap in their adsorption steps, reference being made to Figure 2.

The Examiner's rejection is briefly expressed and fails to point out where specifically each feature of any of the subject claims is to be found. The Applicant submits that in fact, Fuderer fails to disclose a system in which there is a depressurizing step as required in Claim 1 and each of the other subject claims. As a consequence of the lack of a depressurizing step, there is also no disclosure of a repressurization step as required by the claims. Anticipation cannot properly be maintained as a ground for objection unless each and every feature of a subject claim is disclosed in the single reference relied upon. Each of the steps in the cycle of Fuderer is disclosed in the summary presented as steps (a) through (g) in column 2 thereof. The steps do not include depressurization prior to the regeneration steps (b) through (f). The

specific description of the illustrated embodiment makes it clear at column 5, line 13 that item 9 in Figure 1 is a 'blower'. That would be unsuitable for achieving pressurization of the feed air in the system, making it impossible for there to be a depressurization step or a repressurization step.

Therefore, Applicants submit that it is abundantly clear that neither Claim 1 nor any of the other claims is lacking in novelty over Fuderer.

Rejection under 35USC §103(a)

Claims 2 and 19 have been rejected as obvious over Fuderer in view of either US-5,571,309 ("Kumar") or US-5,614,000 ("Kalbassi").

The Examiner argues that these claims differ from Fuderer in requiring that the process and apparatus are used for prepurification of feed gas for a cryogenic air separation device. Applicants submit that this misstates the novelty of the claims and provides a false foundation for the Examiner's argument.

Claim 2, being dependent on Claim 1, shares the novelty discussed above, which is not touched upon in the Examiner's subsequent analysis.

Claim 19 not only is dependent on Claim 1 but itself requires the use of precisely three adsorption beds, whilst Fuderer discloses the use of five beds. Further, if the apparatus of Fuderer were modified to include only three beds, another feature of Claim 1 would not be satisfied. Claim 1 requires that the number of beds in adsorption should always exceed the number of beds in regeneration (i.e. not in adsorption). However, it is essential to the teaching of Fuderer that there should be two beds undergoing regeneration simultaneously, so if there are only three beds, this requirement of Claim 1 can never be satisfied.

Against the possibility that the Examiner might wish to withdraw the allegation of lack of novelty based on Fuderer and to argue instead that the use of depressurization and repressurization is obvious from the secondary references, the following pre-emptive remarks may be of assistance.

Applicants submit that it is necessary to look very closely at the question of why a skilled person would actually be motivated to make such a change in the process of Fuderer. Fuderer is concerned with a process of purifying air drawn off from a paint/print dryer and containing solvents, i.e. liquid organic chemical compounds. They are removed from the air by adsorption onto active carbon in adsorber-filter cartridges. The air obviously starts at atmospheric pressure when it is taken from the environment of the drying machines. It is driven through the purifying system by 'blowers 9', so it is not significantly pressurized before being introduced to the purifier cartridges.

The regenerating gas is 'an inert gas' which is used in a closed loop, i.e. the same gas is used over and over, being cleaned of solvent and water picked up during the bed regeneration before it is used again. The solvent and water are removed from the inert gas in chillers 7 and 8. The problems addressed in Fuderer can be seen in the list of advantages given bridging columns 3 and 4.

These problems are closely tied up with the presence in their feed gas of two non-volatile contaminants that can be removed from the inert regeneration gas by chilling and the realization that hot regeneration gas brings water off the bed under regeneration first and then the solvent.

To determine whether a skilled reader would be motivated to alter the process of Fuderer to introduce a depressurization step and a repressurization step, one should consider to what extent this would assist or hinder or be irrelevant to the aims of Fuderer.

The first point to note is that it is not necessary for practicing Fuderer for the air to be compressed prior to purification. Fuderer simply uses a blower to pass unpressurized air through the system. In order to have depressurization and repressurization steps, one has to be working the whole system at an elevated pressure, so the blower in Fuderer would have to be replaced by a compressor. Compressing air uses energy and so costs money. The reader of Fuderer would not do this unless some compensating benefit could be seen. Indeed, Fuderer itself indicates at column 3, line 60 that avoiding the consumption of energy is a principal benefit of its invention. However, it is plain that there is no benefit obtainable from compressing the feed air. The purified air in Fuderer is simply to be discharged into the atmosphere of the drying

machinery, so must end up at atmospheric pressure. There is simply no point in compressing it prior to the start of the purification process.

The regenerating gas in Fuderer could not of course practically be lower in pressure than the feed gas unless the feed gas was compressed in this purposeless way.

Accordingly, Applicants submits that it is clear that a skilled reader of Fuderer would not modify the process described there to include pressurization and would therefore have no possibility of introducing depressurization and repressurization steps.

If one did seek to modify the process of Fuderer by (a) pressurizing the feed gas and also (b) incorporating depressurization prior to regeneration and repressurization after regeneration, one would need to fit these steps somehow into the sequence of phases shown in Figure 2 of Fuderer. It is not apparent how this could be done as one is requiring two additional phases to be fitted into the sequence.

In relation to Claim 2, it further needs to be considered why it would be appropriate to combine the regeneration processes of Fuderer with an air prepurification process.

Applicants further submit that the apparatus of Fuderer would be fundamentally unsuited to prepurification of air to remove water, carbon dioxide and other relatively high boiling gases such as acetylene. The Fuderer system passes feed air through a bed (say bed 4 in his Fig 1 and 2) until it is in need of regeneration. It then passes heated regenerating gas through a companion bed (bed 3) and leads the effluent from that into the bed to be regenerated (bed 4). This displaces contaminants adsorbed in bed 3 into bed 4 and starts the process of heating bed 4. After a holding period in which bed 4 is completely off-line, heated regenerating gas is fed directly to bed 4 to heat it further and displace contaminants therefrom. During the first part of this two stage regeneration the effluent inert gas from bed 4 goes to chiller 7 to remove solvent and during the second part of the regeneration, the inert gas effluent goes from bed 4 to chiller 8 to remove water. The same inert gas is used continuously for the regeneration of all of the beds in a closed loop.

This whole process is closely tied to the nature of the specific contaminants (solvent and water) that it is designed to deal with. It is only because they can be removed adequately by the chillers 7 and 8 that the process works at all. It would be quite useless for removing carbon dioxide and water from air.

Moreover, the process is mainly designed to recover the solvent reasonably free of water. Whilst the purified air can be reused (col 1, line 13) it can also be vented and is clearly not of value. The prepurification processes of the secondary references have exactly the opposite priorities. There it is the air which is the useful product (as a feed to an air separation process) and the water and carbon dioxide extracted from the air are simply waste.

Fundamentally, the process of the primary reference is so unlike the processes of the secondary references that no skilled person would have really considered combining them. Also, their fundamental incompatibilities would have prevented any such combination.

The problem addressed by the present invention is how to obtain high throughput volumes in a TSA gas purification apparatus without the fluidization and other problems associated with the use of two large adsorbent beds and without the high capital cost of running two parallel pairs of smaller beds (see pages 4 and 5).

A person seeking to solve this problem would be aware of the prior art set out in the introduction of the application, where two beds (or two parallel pairs of smaller beds) are run through cycles of adsorption, depressurization, regeneration, and repressurization. If they were also aware of Fuderer, they would see nothing there disclosing the solution to the problem they faced. Fuderer does not suggest that the use of the multiple beds it discloses would result in good air flow matching that of two pairs of equivalent size beds, as demonstrated in the Examples of this case.

If one looks at Table 1 on page 14, one sees that the simulations of three bed systems, whether large or small beds are used, achieve Air Flow values the same as are obtained for four beds arranged as two parallel pairs. Fuderer on the other hand contains no disclosure of the air flows that are achievable using different bed configurations.

Therefore, it would not have been obvious to modify the prior art to come to a process as claimed in Claim 1.

Claim 2 requires that the process goes on with a downstream cryogenic separation process. Clearly, this could not be done in the context of Fuderer, where the purified gas is to be returned to dryers or discarded. No reason is put forward by the Examiner as to why in reality a reader of Fuderer would be motivated to try to apply its specialized teaching in the field of purification of gas mixtures prior to cryogenic separation. Applicants submit that Claim 2 is independently inventive (not obvious).

Applicants submit that what the Examiner has done is to use hindsight to find a teaching (Fuderer) which lies in a different field from that of the invention and then has taken from Fuderer a particular feature which serves a special purpose in Fuderer which is not transferable to the gas component separation field of the invention for any coherent technical purpose. The combination proposed is based purely on hindsight. This is especially clear when one comes down to claims like Claim 4, where the adsorbents required are entirely inconsistent with the processes described in Fuderer.

Applicants submit therefore that not only is Claim 1 novel and inventive (not obvious) over Fuderer, but several of the dependent claims are separately inventive (not obvious).

Conclusion

Applicants submit that all claims are allowable as written and respectfully requests early favorable action by the Examiner. Applicants' representative would be happy to discuss this case with the Examiner if the Examiner believes that a telephone conversation with Applicants' attorney would expedite prosecution of this application, and the Examiner is cordially invited to call the undersigned attorney of record.

Although it is not believed that any further fees are due, if any additional extension and/or fee is required or if any additional fee for claims is required, please charge Account No. 01-0493.

Respectfully submitted,

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